Please delete the claims numbered 26 through 38. Please enter the following new claims:

39. A set of formulae and coded algorithms, computational processing means, for valuing a security, a basket of cash receipts constituting a single security, or an aggregated portfolio, providing means for analytic valuation and sensitivity functions, and providing computational programming means in calculators, computers, software and spreadsheets, wherein providing means to determine a singular governing yield value for a portfolio, useful to identifying its composite yield basis, wherein said algorithms also providing means to determine governing yield value for a single security isomorphic to said security's yield-to-maturity, wherein also providing means to determine a composite yield basis for cash receipts comprising a basket within a single security, said governing yield values useful to analyzing the pricing of said, or of similar or related, security or portfolio, and to projecting the change in the price of said security or portfolio respective a change in yield curve respective time, said algorithms satisfying a pricing function, said pricing function providing means for valuation and sensitivity functions for fixed-income bonds, equity stocks, or insurance premium policies, respective solely to endogenous variables, of C, Y, and T, said pricing function comprising:

$P = f\{C, Y, T\}$ where C, Y, and T are variables endogenous to the security
P = Market Price
C = Cash Receipts, periodic coupon, dividend or premium payments
Y = Yield, a single term relating security's return, relative to P, C, T
T = Time, a terminal or continuous measure of the life of the security;

wherein said governing yield value mirroring, and having reversion with, the zero spot curve, said governing yield by Formula, Yield M, or, by alternate Formula, Yield Md, comprising:

$$\text{Yield M} = \frac{\sum (\text{Maturity} \times \text{Portfolio Coefficient} \times \text{YieldToMaturity}), \text{ for all issues}}{\sum (\text{Maturity} \times \text{Portfolio Coefficient}), \text{ for all issues}}$$

$$\text{Yield Md} = \frac{\sum (\text{Duration} \times \text{Portfolio Coefficient} \times \text{YieldToMaturity}), \text{ for all issues}}{\sum (\text{Duration} \times \text{Portfolio Coefficient}), \text{ for all issues}}$$

where: Yield M or Yield Md = Governing Yield = Y
Maturity = Time = Maturity in Years, remaining or expected Life
Duration = Weighted Time = Duration in Years (in absolute value)
Portfolio Coefficient = Present Value, per issue/Present Value, Σ issues
Present Value = Accrued Cash Receipts + (bid Price $\times$ Face Value)
Yield-To-Maturity = YTM, a means discounting yield respective time;

said Formulae, as such coded algorithms computing Yield M and Md, comprising:

Yield M = YM =(sum{(M*PC*YTM)$_1$, (M*PC*YTM)$_2$, (M*PC*YTM)$_3$,...})/
(sum{(M*PC)$_1$, (M*PC)$_2$, (M*PC)$_3$,...})
where: M=Maturity; PC=Portfolio Coefficient; YTM=Yield-To-Maturity
where: subscript denotes each item of basket or each security in portfolio

Yield Md= YMD =(sum{(D*PC*YTM)$_1$, (D*PC*YTM)$_2$, (D*PC*YTM)$_3$,...})/
(sum{(D*PC)$_1$, (D*PC)$_2$, (D*PC)$_3$,...})
where: D=Duration; PC=Portfolio Coefficient; YTM=Yield-To-Maturity
where: subscript denotes each item of basket or each security in portfolio.

40. A set of formulae and coded algorithms, computational processing means, providing means for valuation and sensitivity functions useful for financial securities, and providing computational programming means in calculators, computers, software, and spreadsheets, comprising means for generating valuation and sensitivity data, said algorithms comprising means to identifying yield-to-maturity, duration, and convexity of said security or portfolio, and said algorithms comprising means to establishing sensitivity values useful for projecting or estimating the change in price of said security or portfolio respective a change in yield curve, said duration representing the point of immunization, and useful for establishing DV/01 hedge ratios, said convexity curving said change in yield, said set of algorithms comprising:

relation of price to yield-to-maturity, a summation form of discounted cash receipts, such a formula algorithm, for periodic cash receipts, solving Yield-To-Maturity, comprising:

$$\text{Price} = \frac{C}{N} \sum_{T=1}^{NT} (1 + Y/N)^{-T} + (1 + Y/N)^{-NT}$$

where: N=n= # C periods per annum, e.g. semi-annual=2; T=Maturity in years
C = Coupon, Cash Receipts Y = YTM T = Maturity (in years)

said Formula, as such coded algorithm computing Yield-To-Maturity, comprising:

generalized Price= PSUM= (C/N)*(sum{(((1+(Y/N))^(-T))+((1+(Y/N))^(-N*T)))$_1$,...})
where: subscript denotes each periodic cash receipt per annum, totaling N p.a.;

relation of change in price for change in yield, duration, the first order term of a Taylor series approximation to deriving the first derivative of said summed discounted cash receipts, such an integrated formula algorithm, rendering duration (modified annualized), comprising:

$$\text{(Duration) Durmodan} = \frac{\dfrac{C}{Y^2}\left[1 - \dfrac{1}{(1+Y)^{2T}}\right] + \dfrac{2T(100 - C/Y)}{(1+Y)^{2T+1}}}{2P}$$

where: Y=YTM; T=Mat. in Years; C=Coupon, Cash Receipts; P=Price (par=100)

such coded algorithms, for modified annualized duration, periodic cash receipts, comprising:

semi-annual Durmodan=DURMOD=((((C/2)/((Y/2)^2))*(1–(1/((1+(Y/2))^(2*T)))))
+((2*T)*(100–((C/2)/(Y/2))))/((1+(Y/2))^((2*T)+1))))/(2*P)
where: P = Price (of 100 par basis)

generalized Durmodan=DURMD= ((((C/N)/((Y/N)^2))*(1–(1/((1+(Y/N))^(N*T))))
+(((N*T)*(100–((C/N)/(Y/N))))/((1+(Y/N))^((N*T)+1))))/(2*P);

relation of change in the change in yield, convexity, the second order term of a Taylor series approximation to deriving the first derivative of said summed discounted cash receipts, such an integrated formula algorithm, rendering convexity (modified annualized), comprising:

$$\text{(Convexity) Convex} = \frac{\dfrac{2C}{Y^3}\left[1 - \dfrac{1}{(1+Y)^{2T}}\right] + \dfrac{2C(2T)}{Y^2(1+Y)^{2T+2}} + \dfrac{2T(2T+1)(100 - C/Y)}{(1+Y)^{2T+2}}}{4P}$$

such coded algorithms, convexity (annualized, \$100 par), said second order term, comprising:

semi-annual Convex = CON = (((C/((Y/2)^3))*(1–(1/((1+(Y/2))^(2*T)))))
–((C*(2*T))/(((Y/2)^2)*((1+(Y/2))^((2*T)+1))))
+(((2*T)*((2*T)+1)*(100-(C/Y)))/((1+(Y/2))^((2*T)+2))))/(4 P)

generalized Convex = CONDP = (((C/((Y/N)^3))*(1–(1/((1+(Y/N))^(N*T)))))
–((C*(N*T))/(((Y/N)^2)*((1+(Y/N))^((N*T)+1))))
+(((N*T)*((N*T)+1)*(100-(C/Y)))/((1+(Y/N))^((N*T)+2))))/(4*P).

41. A set of formulae and coded algorithms, computational processing means, providing means for valuation and sensitivity functions useful for financial securities, and providing computational programming means in calculators, computers, software, and spreadsheets, comprising means for generating valuation and sensitivity data, said algorithms comprising means to identifying yield-to-maturity, duration, and convexity of said security or portfolio, and said algorithms comprising means to establishing sensitivity values useful for projecting or estimating the change in price of said security or portfolio respective a change in yield curve, said duration representing the point of immunization, and useful for establishing DV/01 hedge ratios, said convexity curving said change in yield, said set of algorithms comprising:

relation of price to yield-to-maturity, a non-summation form discounting cash receipts, such a formula algorithm, for periodic cash receipts, solving Yield-To-Maturity, comprising:

$$\text{Price} = \frac{C}{Y}\left(1-(1+Y/N)^{-NT}\right) + (1+Y/N)^{-NT}$$

where: N=n= # C periods per annum, e.g. semi-annual=2; T=Maturity in years
C = Coupon, Cash Receipts Y = YTM T = Maturity (in years)

said Formula, as such coded algorithms computing Yield-To-Maturity, comprising:

semi-annual P = PR = ((C/Y)*(1-(1+(Y/2))^(-2*T))+(1+(Y/2))^(-2*T)
where: C, Y and P are decimal values, T=Maturity in years

generalized P = PRBOND= ((C/Y)*(1-(1+(Y/N))^(-N*T))+(1+(Y/N))^(-N*T);

change in price for change in yield, duration, first derivative of non-summation form, a non-tautological expression of duration, whereas not requiring price in its computation, and utilizing only the endogenous variables of C, Y, and T, said duration useful both respective Y variable defined as YTM or as Yield M (Md), and whereas said duration computing having negative magnitude, consistent with Einstein's time/space fourth dimension, duration, said duration deriving by chain rule of derivative calculus as δP/δY, defining variable, K, such K, for modified annualized duration, written as Formula, having alternate Formulae, comprising:

semi-annual $K = \frac{-C}{Y^2}(1 - (1+Y/2)^{-2T}) + \frac{C}{Y}(T + TY/2)^{-2T-1} - (T + TY/2)^{-2T-1}$

where: C=Coupon, Cash Receipts Y=YTM, or Yield M (or Md) T=Mat. in Years

generalized $K = \frac{-C}{Y^2}(1 - (1+Y/N)^{-NT}) + \frac{C}{Y}(T + TY/N)^{-NT-1} - (T + TY/N)^{-NT-1}$

where: N=n= # C periods per annum, e.g. semi-annual=2;

wherein, also deriving by chain rule, such Formula also alternately written:

semi-annual $K = \frac{-C}{Y^2} + \frac{C}{Y^2}(1+Y/2)^{-2T} - (1 - C/Y)(T + TY/2)^{-2T-1})$

generalized $K = \frac{-C}{Y^2} + \frac{C}{Y^2}(1+Y/N)^{-NT} - (1 - C/Y)(T + TY/N)^{-NT-1})$

said Formulae, as such coded algorithms computing K, respectively, comprising:

semi-annual K = DURK =
```
((-C/(Y^2))*(1-((1+(.5*Y))^(-2*T))))
+((C/Y)*((T+(.5*Y*T))^((-2*T) -1))
```
where C and Y are decimal values, T=Maturity in years

generalized K =BONK=
```
((-C/(Y^2))*(1-((1+(Y/N))^(-N*T))))
+((((C/Y) -1)*T*((1+(Y/N))^((-N*T)-1)))
```
where C and Y are decimal values; N=n= #C periods per annum; T=Maturity in years

semi-annual K = DPDY =
```
((-C/(Y^2))*(1-((1+(.5*Y))^(-2*T))))
+((C/Y)*((T+(.5*Y*T))^((-2*T) -1)))
-((T+(.5*Y*T))^((-2*T) -1))
```
where C and Y are decimal values, T=Maturity in years

generalized K = DPDYN =
```
((-C/(Y^2))*(1-((1+(Y/N))^(-N*T))))
+((C/Y)*((T+((Y/N)*T))^((-2*T) -1)))
-((T+((Y/N)*T))^((-2*T) -1))
```
where: C and Y are decimal values, N=n=#C periods per annum; T=Maturity in years;

change in the change in yield, convexity, second derivative of non-summation form, an exact and true second derivative, a non-tautological expression of convexity, whereas not requiring price in its computation, and utilizing only the endogenous variables of C, Y, and T, whereas said convexity defining curvature of the first derivative, and effecting reversion between Yield M and the zero spot (where Y = (Yield M –YTM)), said convexity deriving by chain rule of derivative calculus, defining variable, V, such V written as Formula, comprising:

$$V = \frac{2C}{Y^3} - \frac{\frac{2C}{Y^3}}{(1+Y/2)^{2T}} - \frac{\frac{CT}{Y^2}}{(1+Y/2)^{2T+1}} - \frac{\frac{C}{Y^2}}{(T+TY/2)^{2T+1}} + \frac{(1+C/Y)(T^2+T/2)}{(T+TY/2)^{2T+2}}$$

wherein V = K′ and V = non-summation form″
wherein calculating V using Y = YTM, Y = Yield M or Md, or Y = (Yield M−YTM)

said Formula, as such coded algorithms computing second derivative, V, comprising:

generalized

V =BONV= (((2*C)/(Y^3))*(1−(1+(Y/N))^(-N*T)))
−((C/Y^2)*(2*T)*((1+(Y/N))^((-N*T) −1)))
−(((C/Y) −1)*(((N*T)+1)*(T/N))*((1+(Y/N))^((-N*T) −2)))

where C and Y are decimal values; N=n= #C periods per annum; T=Maturity in years
where e.g. Y=spread=YieldM−YTM, expressed in decimal, i.e. if Y=0.14%=0.14
where e.g. Y=Yield M, expressed in decimal, i.e. if Y= Yield M= 6.06%= 0.0606
where e.g. Y=YTM, expressed in decimal, i.e. if Y= YTM= 6.06%= 0.0606

spread-based, semi-annual

V =VEXA= (((2*C)/(Y^3)) −(((2*C)/(Y^3))*((1+(Y/2))^(-2*T)))
−((C*T)/(Y^2))*((1+(Y/2))^((-2*T) −1))
−((C/(Y^2))*((T+(T*(Y/2)))^((-2*T) −1)))
+((1+(C/Y))*((T^2)+(T/2))*((T+(T*(Y/2)))^((-2*T) −2))))/10000

where C and Y are decimal values; N=n= #C periods per annum; T=Maturity in years
where e.g. Y=spread=YieldM−YTM, expressed in decimal, i.e. if Y=0.14%=0.14
where e.g. Y=Yield M, expressed in decimal, i.e. if Y= Yield M= 6.06%= 0.0606
where e.g. Y=YTM, expressed in decimal, i.e. if Y= YTM= 6.06%= 0.0606

spread-based, generalized

V =VEX= (((2*C)/(Y^3)) −(((2*C)/(Y^3))*((1+(Y/N))^(-N*T)))
−((C*T)/(Y^2))*((1+(Y/N))^((-N*T) −1))
−((C/(Y^2))*((T+(T*(Y/N)))^((-N*T) −1)))
+((1+(C/Y))*((T^2)+(T/N))*((T+(T*(Y/N)))^((-N*T) −2))))/10000

where C and Y are decimal values; N=n= #C periods per annum; T=Maturity in years
where e.g. Y=spread=YieldM−YTM, expressed in decimal, i.e. if Y=0.14%=0.14
where e.g. Y=Yield M, expressed in decimal, i.e. if Y= Yield M= 6.06%= 0.0606
where e.g. Y=YTM, expressed in decimal, i.e. if Y= YTM= 6.06%= 0.0606.

42. A process for the manufacture of financial data using the endogenous variables of a financial security, useful to estimating change in the security's price given change in its yield, and useful to quoting yield and for setting hedge ratios and immunization, which comprises:

identifying the data values for the security's endogenous variables, of C, Y, and T;

determining governing yield, for a single security issue, or for a portfolio of issues, or for a basket of divisible cash receipts, wherein applying processing function Yield M (or Md), entailing determining Yield-To-Maturity per summation form or per non-summation form;

determining arbitrage spreads between Yield M and zero spot, and Yield M and YTM;

calculating an empirical price, utilizing said endogenous and determined values of C, Yield M, and T, by solving price, using said summation form or said non-summation form;

determining measures of the security's pricing sensitivities, duration and convexity, as Taylor series first and second order terms of first derivative solution of YTM summation form, or as first and second derivatives of YTM non-summation form (K and V), respectively.

43. A method for valuing a security by its endogenous variables, useful to quoting said security's yield and for setting hedge ratios and immunization and to estimating change in the security's price given change in its yield with respect to time, comprising steps of:

identifying the data values for the security's endogenous variables, of C, Y, and T;

establishing Yield M (or Md), using means performing process, or as spot quotes;

utilizing said security's values of C, Yield M, T, calculating said security's price:

solving for price, by processing either summation or non-summation form;

utilizing values of C, Yield M, T, calculating duration and convexity price sensitivity:

solving for duration, as Taylor series first order term of first derivative solution of YTM summation form, or as first derivative of YTM non-summation form (K);

solving for convexity, as Taylor series second order term of first derivative solution of YTM summation form, or as second derivative of YTM non-summation form (V).

44. A method for estimating change in price of a security, or of an aggregated portfolio, given change in yield, $\Delta P/\Delta Y$, instantaneous or as occurring over time, useful to projecting and forecasting future values of said security or portfolio given change in yield over time, comprising steps of:

utilizing data values of said security's Yield, Duration, and Convexity, wherein Yield variable of YTM, or Yield M or Yield Md, Duration variable of K, Convexity variable of V;

identifying change in said Yield data value occurring instantaneously or over time;

determining the change in price of the security given said change in said Yield (Y) by implementing factorization, wherein utilizing K for duration, Δ Price, due to Duration (K):

$$\text{A:} \quad \Delta \text{ Price, due to Duration (K)} = K \times \Delta\ Y;$$

determining the change in price of the security given said change in said Yield by implementing factorization, wherein utilizing V for convexity, Δ Price, due to Convexity (V):

$$\text{B:} \quad \Delta \text{ Price, due to Convexity (V)} = \tfrac{1}{2} \times V \times (\Delta\ Y)^2;$$

summing the values determined by A+B, whereby computing Δ Price, due to K and V:

$$\Delta \text{ Price} = (K \times \delta Y) + (\tfrac{1}{2} \times V \times (\delta Y)^2)$$

wherein $\delta Y \cong \Delta Y = \Delta$Yield M, or ΔYTM non-summation or summation form;

determining arbitrage spread of computed Δ Price versus actual notched Δ Price.

45. The method of claim 44, which further comprises an universal factorization:

$$\Delta \text{ Price} = (-\,|\text{Duration}| \times \delta Y) + (\tfrac{1}{2} \times \text{Convexity} \times (\delta Y)^2)$$

wherein $\delta Y \cong \Delta Y = \Delta$Yield M, or ΔYTM non-summation, or summation form

Duration = $\delta P/\delta Y$ of K, or first derivative solution of YTM summation form

Convexity = K' of V, or second derivative solution of YTM summation form.

46. The method of claim 44, which further comprises adding a derivative respecting time, and further comprises adding any accrued interest, wherein using dirty price within A and B:

$$\Delta P = A + B + C + D$$

wherein,

$\Delta P =$ change in bid price, for given changes in yield and time,

$A = -\text{abs(Duration)} \times \text{Price(dirty)} \times \Delta Y$

$B = \frac{1}{2} \times \text{Convexity} \times \text{Price(dirty)} \times (\Delta Y)^2$

$C = \text{Theta} \times \text{Price(dirty)} \times \Delta t$

$D = -(\Delta$ Accrued Interest, for given $\Delta t)$,

and wherein,

$\Delta Y = \Delta$Yield M, or ΔYTM non-summation or summation form,

Duration $= \delta P/\delta Y$ of K, or first derivative solution of YTM summation form,

Convexity $= K'$ of V, or second derivative solution of YTM summation form,

Theta (θ), such a theta: $\theta = 2 \ln(1+r/2)$, $r =$ ytm,

Price (dirty) equals bid price plus accumulated interest,

Δt is elapsed time between two points in time on which estimations are made,

ΔP rounded to nearest market pricing gradient, ΔP occurring Δt, determining arbitrage spread of computed Δ Price versus actual notched Δ Price.

47. A method for valuing a financial portfolio, containing more than one issue or security, or for valuing a basket of cash receipts comprising a single security, by singular portfolio (P) data values of endogenous variables C^P, Y^P, and T^P, said method also to comparing portfolios, and to hedging, immunizing and replicating a portfolio of securities, comprising steps of:

identifying the data values for each security's endogenous variables of C, Y, and T:

wherein C = periodic Coupon, Dividend or Premium Cash Receipt Rate,

Y = YTM of non-summation or summation form, or Yield M,

T = Maturity, Term or expected Life, in Years;

generating the portfolio coefficients for each security or cash receipt, computing:

Portfolio Coefficient, per each Issue = $\text{Present Value}^{I}/\text{Present Value}^{P}$;

Present Value^{I} = (AI + (Bid Price×Face Value)), per Issue (I);

Present Value^{P} = $\sum$ (AI+(Bid Price×Face Value), for all Issues;

generating aggregate portfolio (P) data relating portfolio's value, computing:

Present Value^{P} = $\sum$ (AI + (Bid Price × Face Value), for all Issues;

$\text{Accrued Interest}^{P}$ = $\sum$ Accrued Interest, AI, for all Issues;

Face Value^{P} = $\sum$ Face Value, for all Issues;

Implied Price^{P} = $(\text{Present Value}^{P} - AI^{P})/ \sum$ Face Value for all Issues;

generating aggregate portfolio (P) data relating portfolio's variables, computing:

C^{P} = Cash Receipts^{P} = $\sum$ C × Portfolio Coefficient, for all Issues;

T^{P} = Time^{P} = $\sum$ Maturity × Portfolio Coefficient, for all Issues;

Y^{P} = Yield^{P} = $\sum$ Yield × Portfolio Coefficient, for all Issues;

processing C, Y, and T, per issue, portfolio's duration and convexity, computing:

Duration^{P} = $\sum$ Duration × Portfolio Coefficient, for all Issues;

Convexity^{P} = $\sum$ Convexity × Portfolio Coefficient, for all Issues.

or utilizing portfolio values, C^{P}, Y^{P}, and T^{P}, computing:

Duration^{P} = K, or first derivative solution of YTM summation form;

Convexity^{P}=V, or second derivative solution of YTM summation form.

48. An apparatus, an analytic valuation engine, generating financial data, by automated computation, of values and sensitivities for a security or portfolio, and rendering, displaying, storing, or transmitting said data in databases, memory, arrays or spreadsheets, said apparatus having means porting to external computer systems or business logic engines, comprising:

means capturing values from data-feed, stored memory or by simulation, for a security, or for securities in a portfolio, of data of endogenous variables of C, Y and T, and of price, P;

means computing governing yield, Yield M, or Md, for said security or portfolio, and computing said security's or portfolio's yield by YTM summation and non-summation forms;

means accessing governing yield and YTM yield data values in processing, wherein utilizing Yield M data, computing duration, K, and convexity, V, and theta, data, and wherein utilizing YTM non-summation form data, computing duration, K, and convexity, V, and theta, data, and wherein utilizing YTM summation form data, computing duration by first derivative Taylor approximation and convexity by second derivative approximation, and theta, data;

means sending said governing yield, and its convexity, duration, and theta, data set to storage, and means computing factorization data of change in price for change in yield, and sending market yield data and its data set to storage and means computing said factorization;

means tabling, charting and rendering said generated data of security or portfolio;

means transmitting said data to monitors, printers, external systems or engines.

49. An apparatus, an automated arbitrage engine, processing financial data by computer, identifying arbitrage differentials and sorting said identifications, and rendering, displaying, storing, or transmitting said data in databases, memory, arrays or spreadsheets, said apparatus having means porting to external computer systems or business logic engines, comprising:

means capturing financial data from storage, data-stream, external system or engine;

means computing an arbitrage differential between spot yield and governing yield;

means computing an arbitrage differential between precise price change and actual;

means sorting arbitrage opportunities of securities by profit, spread or notch premium;

means executing transactions based on most profitable sorted arbitrage opportunities;

means tabling, charting and rendering said computed data of said security or portfolio;

means transmitting said data to storage, external systems, components, or engines.

50. An integrated computer-based financial information and transaction processing system providing analytic processing, assessment of arbitrage spreads and execution of transactions, useful for automated computation of values and sensitivities, for automated computation of arbitrage differentials, and for real-time processing of transactions based thereon, comprising:

two server-based systems housing analytic valuation and automated arbitrage engines;

real-time financial data-feed, wherein each said business logic server engine receiving market pricing data through said data-feed, wherein data delivered by signal to processing;

porting connections between said server-based engines and from each said engine to output, rendering and storage device, said devices comprising printers, terminals and memory;

automated control sequences providing means rechecking pricing on sorted arbitrage opportunities, and means executing computer-automated transactions of most profitable;

telecommunications connections between engines, data-feeds and external entities, said entities comprising the group of exchanges, broker/dealers, and investment houses;

automated storage control sequences, updating and retrieving transaction inventory;

protective devices, comprising the group of encryption, gate-keepers and fire-walls.

Prepared by David Andrew D'Zmura David Andrew D'Zmura